

# Exhibit 16

Maarit Niinimäki et al., *Immediate Complications After Medical Compared With Surgical Termination of Pregnancy*, 114 *Obstetrics & Gynecology* 795 (2009)

# Immediate Complications After Medical Compared With Surgical Termination of Pregnancy

*Maarit Niinimäki, MD, Anneli Pouta, MD, PhD, Aini Bloigu, Mika Gissler, BSc, PhD, Elina Hemminki, MD, PhD, Satu Suhonen, MD, PhD, and Oskari Heikinheimo, MD, PhD*

**OBJECTIVE:** To estimate the immediate adverse events and safety of medical compared with surgical abortion using high-quality registry data.

**METHODS:** All women in Finland undergoing induced abortion from 2000–2006 with a gestational duration of 63 days or less ( $n=42,619$ ) were followed up until 42 days postabortion using national health registries. The incidence and risk factors of adverse events after medical ( $n=22,368$ ) and surgical ( $n=20,251$ ) abortion were compared. Univariable and multivariable association models were used to analyze the risk of the three main complications (hemorrhage, infection, and incomplete abortion) and surgical (re)evacuation.

**RESULTS:** The overall incidence of adverse events was fourfold higher in the medical compared with surgical abortion cohort (20.0% compared with 5.6%,  $P<.001$ ). Hemorrhage (15.6% compared with 2.1%,  $P<.001$ ) and incomplete abortion (6.7% compared with 1.6%,  $P<.001$ )

were more common after medical abortion. The rate of surgical (re)evacuation was 5.9% after medical abortion and 1.8% after surgical abortion ( $P<.001$ ). Although rare, injuries requiring operative treatment or operative complications occurred more often with surgical termination of pregnancy (0.6% compared with 0.03%,  $P<.001$ ). No differences were noted in the incidence of infections (1.7% compared with 1.7%,  $P=.85$ ), thromboembolic disease, psychiatric morbidity, or death.

**CONCLUSION:** Both methods of abortion are generally safe, but medical termination is associated with a higher incidence of adverse events. These observations are relevant when counseling women seeking early abortion. (*Obstet Gynecol* 2009;114:795–804)

**LEVEL OF EVIDENCE: II**

Termination of pregnancy is one of the most common gynecologic procedures. For instance, in the United States, nearly half of pregnancies are unintended,<sup>1</sup> and 22% of all pregnancies (excluding miscarriages) end in termination.<sup>2</sup> Abortion practices have changed dramatically in recent years since the medical method with antiprogesterone mifepristone and prostaglandins was introduced. For example, in 2007 in Finland 64%,<sup>3</sup> in Sweden 61%,<sup>4</sup> and in the United Kingdom 35%<sup>5</sup> of all abortions were performed using the medical method. Thus, the safety of induced abortion in general, especially that of the medical method, is of great public health interest.

Most previous studies focused on the short-term complications of induced abortion have been small or have not involved comparison of the two dominant methods of abortion (medical and surgical). In a large, register-based study, 5% of the patients had a complication (bleeding, infection, or (re)evacuation) after surgical abortion during a short-term follow-up period of 2 weeks.<sup>6</sup> In a previous meta-analysis in which medical and surgical termination of pregnancy in the

*From the Department of Obstetrics and Gynecology, Oulu University Hospital, the Graduate School of Circumpolar Wellbeing, Health and Adaptation, and the National Institute for Health and Welfare, Oulu, Finland; and the National Institute for Health and Welfare and the Nordic School of Public Health, the Department of Obstetrics and Gynecology, Helsinki University Central Hospital, Helsinki, Finland.*

*Funded by Helsinki University Central Hospital (Drs. Suhonen and Heikinheimo), University Hospital of Oulu (Dr. Niinimäki), and The Finnish Cultural Foundation (Dr. Niinimäki).*

*The authors thank Matti Kesti for his help with computation.*

*Corresponding author: Dr. Oskari Heikinheimo, Dept Ob&Gyn, Helsinki University Central Hospital, P.O. Box 140, 00029-HUS, Helsinki, Finland; e-mail: oskari.heikinheimo@helsinki.fi.*

## Financial Disclosure

*Dr. Suhonen has lectured at meetings organized by Schering Plough (Helsinki, Finland). Dr. Heikinheimo has been a paid consultant and lecturer for Bayer Schering Pharma AG (Berlin, Germany) and for Schering-Plough (Helsinki, Finland). He also belongs to both the international and Finnish advisory boards for Bayer Schering Pharma. The other authors did not disclose any potential conflicts of interest.*

© 2009 by The American College of Obstetricians and Gynecologists. Published by Lippincott Williams & Wilkins.

ISSN: 0029-7844/09



first trimester were compared, no differences in pelvic infection or ongoing pregnancies were noted between the methods. Evidence of different rates of other potential side effects or complications between the two abortion techniques could not be confirmed because the trials included were small.<sup>7</sup>

Only a few randomized controlled trials have been performed to compare success rates and complications between medical and surgical abortion.<sup>8–10</sup> In a previous, partly randomized study, no difference in the number of complications was noted. Although the rate of complete abortion was significantly higher in the surgical group (98% compared with 94%), the surgically treated women had a higher incidence of antibiotic treatment than did those undergoing medical abortion.<sup>8</sup> In another randomized controlled trial, complete abortion without a second procedure occurred in 98% of cases after surgical abortion and in 95% after medical abortion. Moreover, no differences in the rates of major complications were observed.<sup>11</sup>

The purpose of the present study was to compare medical and surgical abortion in regard to the incidence and risk factors of immediate (ie, within 42 days after termination of pregnancy) adverse events and complications in a large nationwide cohort. A nationwide cohort with high-quality data derived from national health registries offers the possibility to estimate extensively the risk of adverse events associated with the two methods of early termination of pregnancy. Using this same cohort, we recently reported that the risk of repeat abortion after medical compared with surgical termination of pregnancy depends on various sociodemographic factors but not on the method of abortion.<sup>12</sup>

## MATERIALS AND METHODS

This was a cohort study including all women undergoing termination of pregnancy in Finland between January 1, 2000, and December 31, 2006. According to the current law on induced abortions, women need permission with legal indication for termination of pregnancy, but the legislation is interpreted liberally. The Finnish legislation on induced abortion<sup>13</sup> was summarized in our recent study.<sup>12</sup>

The present study was conducted after receiving approval from the ethics committee of the Northern Ostrobothnia Hospital District. The Ministry of Social Affairs and Health and Statistics Finland gave their permission to use the confidential personal-level data from the registries. The Data Protection Ombudsman was notified regarding the data linkage before the analyses as required by the national data-protection legislation.

All women who underwent induced abortion by either medical or surgical methods at a gestational age of 63 days or less were included. The duration of gestation was limited to 63 days because, during the study period of 2000–2006, medical abortions, for the most part, were performed only up to that time.<sup>14</sup> The time of follow-up after abortion was 42 days (6 weeks). Medical abortion was defined as the use of mifepristone alone or in combination with misoprostol or other prostaglandins. Surgical abortion included induced abortions with dilation and curettage or vacuum aspiration. The participants were divided into two arms of the study according to the primary abortion method. For women having more than one abortion, only the first termination of pregnancy during the study period was included.

The study was based on three national registries: the Abortion Registry,<sup>3</sup> the Care Registry for Health Institutions (later renamed the Hospital Registry)<sup>15</sup> compiled by the National Institute for Health and Welfare, and the Cause-of-Death Registry of Statistics Finland.<sup>16</sup> The study participants were selected from the Abortion Registry as described in our previous study,<sup>12</sup> after which the other registries were linked with the cohort.

We linked information on the study participants in the Hospital Registry concerning all hospital-inpatient episodes (all hospitals) and outpatient visits (public hospitals) within 42 days after termination of pregnancy to analyze complications related to induced abortion. All of the diagnoses (based on the International Classification of Diseases [ICD]-10, International Statistical Classification of Diseases and Related Health Problems<sup>17</sup>) and codes for surgical procedures (based on the Nordic Classification of Surgical Procedures<sup>18</sup>) found in the cohort were evaluated to select those considered to be of clinical importance.

Complications were divided into seven categories: 1) hemorrhage (all reported hemorrhages), 2) postabortal infections (pelvic inflammatory disease, endometritis, cervicitis, wound infections, pyrexia of unknown origin, urinary tract infections, and septicemia), 3) incomplete abortion (surgical [re]evacuation, any reported incomplete abortion), 4) injuries or other reasons for surgical operation (all injuries, cervical laceration, uterine perforation, all surgical interventions during the time of follow-up), 5) thromboembolic disease (pulmonary embolism, deep vein thrombosis), 6) psychiatric morbidity (depression, intoxication, psychoses) and 7) death (death from any cause, pregnancy-related death according to the World Health Organization definition). The classification was based on that reported in the Joint Study of



the Royal College of General Practitioners and the Royal College of Obstetricians and Gynaecologists<sup>19</sup> and modified for the present study.

The Cause-of-Death Register kept by Statistics Finland contains data from death certificates and includes all deaths of Finnish citizens and permanent residents in Finland classified according to ICD-10 codes.<sup>20</sup> All of the early deaths (within 42 days of termination of pregnancy) were classified as direct, indirect, or unrelated. This classification was based on that in an earlier study by Deneux-Tharaux et al.<sup>21</sup>

Differences between the groups were assessed using Student's *t*-test for continuous variables and the  $\chi^2$  test for categorical variables. Logistic regression analyses were performed to adjust for the differences in background characteristics in the comparisons of medical and surgical abortions. Furthermore, logistic regression was used to identify risk factors for complications. Variables that showed statistically significant associations with complications in univariable analysis were further entered in multivariable analysis. The estimated risks are presented as odds ratios with 95% confidence intervals. The statistical analyses were performed by using SPSS 16.0 for Windows (SPSS Inc., Chicago, IL).

## RESULTS

The total number of women in the cohort was 42,619. Of these, 22,368 had primary medical and 20,251 primary surgical termination of pregnancy. The characteristics of the women in the cohort are presented in Table 1. The women in the medical-abortion cohort were somewhat younger and more often primigravid, nulliparous, and single. The most notable difference between the groups was the shorter duration of gestation in the cohort undergoing medical abortion; surgical abortions in Finland usually are performed after the 6th week of gestation.

The incidence of various adverse events and complications is shown in Table 2. The most common adverse events were hemorrhage and incomplete abortion, both of which were more common in the medical group. The incidence of infection did not differ between the groups. Injuries requiring operation were rare but were more common in the surgical group. No differences between the two groups were noted in the incidence of thromboembolic disease, psychiatric morbidity, or death, partly because the overall incidence of these events was low. All of the deaths were unrelated to pregnancy: suicide ( $n=3$ ),

homicide ( $n=1$ ), subarachnoid hemorrhage ( $n=1$ ), and traffic accident ( $n=1$ ).

When comparing the numbers of women with adverse events or complications, the difference between the two groups was notable: 20% of women in the medical-abortion group and 5.6% of women in the surgical-abortion group had at least one type of adverse event. When looking at the number of complications per patient, there were fewer multiple complications after surgical abortion (Table 2).

We also analyzed the three most common complications in relation to the duration of gestation (Fig. 1). In the medical-abortion cohort, the proportion of women with hemorrhage decreased with advancing duration of gestation; with surgical abortion it increased, albeit not significantly. In both groups, the incidence of infection and incomplete abortion increased with advancing duration of gestation.

Univariable and multivariable analyses were performed concerning the risk factors for three major classes of complications (hemorrhage, infection, and incomplete abortion) and for surgical (re)evacuation, separately for the medical and surgical abortion cohorts (Table 3), and for the whole cohort combined (Fig. 2). In multivariable analysis, the risk of hemorrhage after medical abortion was increased in the age group of 20–24 years, among parous women, among those of lower socioeconomic status, and among those living in densely populated or rural areas. The risk decreased with advancing duration of gestation. After surgical termination of pregnancy, an increased risk of hemorrhage was seen in the age groups of 20–24, 25–29, 30–34, and 35–39 years when compared with women younger than 20 years. A rural type of residence was associated with a decreased risk of hemorrhage.

Multivariable analysis revealed an increased risk of infection after medical abortion in the age group of 20–24 years and with advanced duration of gestation of 50–56 and 57–63 days. After surgical abortion, an increased risk of infection was found in the age group of 20–24 years, with increasing duration of gestation, and among women of lower socioeconomic class. A decreased risk of infection was associated with parity and with women living in densely populated or rural areas.

The risk factors associated with incomplete medical abortion were age of 20–24 years, parity, previous abortion, being single, living in a densely populated or rural area, and advanced duration of gestation. The risk of experiencing incomplete surgical abortion was associated with previous abortion, cohabiting or being single, and with a duration of gestation of 57–63 days.

In multivariable analysis, the risk of bleeding was almost eightfold higher, the risk of incomplete abor-



Table 1. Characteristics of the Participants Included in the Study

	Medical Abortion (n=22,368)	Surgical Abortion (n=20,251)	P
Age (y)			
Median (mean)	25.0 (26.3)	26.0 (27.3)	<.001
95% confidence interval	26.2–26.4	27.2–27.4	
Age category (y)			
Younger than 20	5,058 (22.6)	4,352 (21.5)	<.001
20–24	5,665 (25.3)	4,337 (21.4)	
25–29	4,098 (18.3)	3,442 (17.0)	
30–34	3,406 (15.2)	3,393 (16.8)	
35–39	2,934 (13.1)	3,130 (15.5)	
40 or older	1,207 (5.4)	1,596 (7.9)	
Parity			
0	12,819 (57.3)	10,171 (50.2)	<.001
1	3,444 (15.4)	3,384 (16.7)	
2	3,897 (17.4)	4,125 (20.4)	
3 or more	2,207 (9.9)	2,570 (12.7)	
Previous abortions			
0	18,626 (83.3)	15,461 (76.4)	<.001
1	2,856 (12.8)	3,471 (17.1)	
2	664 (3.0)	927 (4.6)	
3 or more	221 (1.0)	390 (1.9)	
Marital status			
Married	4,350 (19.5)	4,718 (23.3)	<.001
Cohabiting	3,592 (16.1)	3,113 (15.4)	
Single	14,394 (64.4)	12,412 (61.3)	
Social status			
Upper white-collar worker	1,595 (7.1)	1,497 (7.4)	<.001
Lower white-collar worker	4,799 (21.5)	4,794 (23.7)	
Blue-collar worker	2,691 (12.0)	3,060 (15.1)	
Student	7,598 (34.0)	5,990 (29.6)	
Other	1,072 (4.8)	1,386 (6.8)	
Unknown	4,613 (20.6)	3,524 (17.4)	
Type of residence			
Urban	16,668 (74.5)	15,118 (74.7)	<.001
Densely populated area	2,788 (12.5)	2,286 (11.3)	
Rural	2,912 (13.0)	2,847 (14.1)	
Indication for abortion			
Social reasons	19,691 (88.0)	17,175 (84.8)	<.001
Age 17 y or younger	1,507 (6.7)	1,459 (7.2)	
Age 40 y or older	754 (3.4)	1,076 (5.3)	
Four children or more	366 (1.6)	457 (2.3)	
Other	50 (0.2)	84 (0.4)	
Duration of gestation (d)			<.001
42 or fewer	6,012 (26.9)	1,895 (9.4)	
43–49	7,355 (32.9)	4,724 (23.3)	
50–56	6,014 (26.9)	7,033 (34.7)	
57–63	2,987 (13.4)	6,599 (32.6)	

Data are n (%) unless otherwise specified.

tion was fivefold higher, and the risk of (re)evacuation was twofold higher after medical abortion compared with surgical abortion. The risk of infection, as derived from univariable analysis, was not associated with the method of abortion.

DISCUSSION

In the present study, we found that the two methods of pregnancy termination (medical and surgical) are

generally safe. However, the incidence of the two most common adverse events (hemorrhage and incomplete abortion) were notably higher among women undergoing medical abortion, whereas complications requiring surgical treatment, although rare, were more common after surgical abortion. The rates of postabortal infection and serious morbidity (such as thromboembolic events) did not differ between the two groups. There were no pregnancy-related deaths



Table 2. Incidence of Adverse Events in the Cohort

	Medical Abortion (n=22,368)	Surgical Abortion (n=20,251)	P*	Adjusted OR† (95% CI)
Hemorrhage	3,487 (15.6)	433 (2.1)	<.001	7.93 (7.15–8.81)
Hemorrhage with surgical (re)evacuation	645 (2.9)	173 (0.9)	<.001	
Infection	383 (1.7)	342 (1.7)	.85	1.15 (0.98–1.34)
Infection with surgical (re)evacuation	172 (0.8)	122 (0.6)	.02	
Incomplete abortion	1,495 (6.7)	323 (1.6)	<.001	5.37 (4.49–6.28)
Incomplete abortion with surgical (re)evacuation	1,320 (5.9)	77 (0.4)	<.001	
Injury	6 (0.03)	122 (0.60)	<.001	NA‡
Thromboembolic disease	18 (0.08)	17 (0.08)	.90	NA
Psychiatric morbidity	2 (0.009)	1 (0.005)	.62	NA
Death	2 (0.009)	4 (0.020)	.35	NA
Women with adverse events	4,479 (20.0)	1,127 (5.6)	<.001	4.23 (3.94–4.54)
Surgical (re)evacuation	1,320 (5.9)	363 (1.8)	<.001	3.58 (3.18–4.03)
Number of adverse events per woman				
0	17,889 (80.0)	19,124 (94.4)	<.001	
1	3,624 (16.2)	1,021 (5.0)		
2	796 (3.6)	97 (0.5)		
3	59 (0.26)	9 (0.04)		

OR, odds ratio; CI, confidence interval; NA, not applicable.  
Data are n (%) unless otherwise specified.  
\* Chi-square test for comparison between medical and surgical cohort.  
† Surgical cohort as a reference adjusted for age, parity, previous abortion, social status, marital status, type of residence, and duration of gestation.  
‡ Not applicable owing to small number of patients in one or both groups.

in our data. Because medical abortion is being used increasingly in several countries, it is likely to result in an elevated incidence of overall morbidity related to termination of pregnancy.

The present study covers almost all of the induced abortions performed in Finland during the years 2000–2006 and thus is a unique data source regarding even uncommon adverse events. However, the validity of the data is a potential problem in register-based studies such as the present one. In the Registry of Induced Abortions, 95% of the informa-

tion has been proven to be identical to that in medical records.<sup>22</sup> However, the reliability of diagnoses and interventions can vary, and underreporting or overreporting by physicians cannot be ruled out. In addition, the Hospital Registry, which was used as a data source, contains data concerning hospital care only. Thus, adverse events dealt with outside the public hospital system, especially those treated in primary health care, will have been missed. Moreover, a single patient may have various diagnoses and complications, such as incomplete abortion and bleeding, and thus may have been registered more than once. The participants, however, each had a unique personal identification number, and we were able to eliminate double counting in our study.

It is important to note that the severity of the diagnoses found in the Hospital Registry may vary substantially. Thus, another problem in this kind of study is the definition of criteria for complications and adverse events. We evaluated all the ICD-10 diagnoses and codes for surgical procedures included in the Hospital Registry and classified them into seven categories.<sup>19</sup> In addition, women choosing surgical and medical abortion differed subtly in several respects and thus may be prone to different types of adverse events.

The rate of consultation related to a diagnosis of hemorrhage was high and eight times more common after medical termination of pregnancy. Because

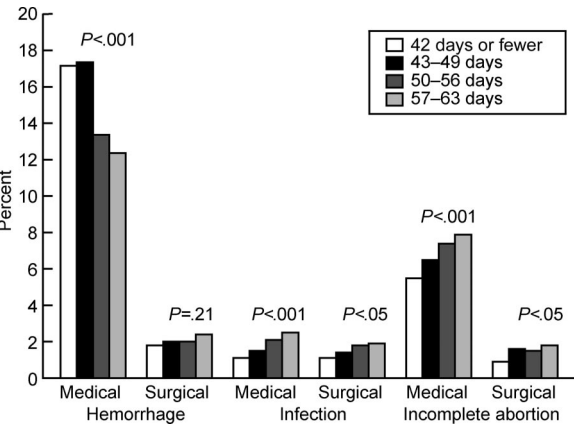


Fig. 1. Complications according to the duration of gestation in the medical and surgical cohorts (%).  
Niinimäki. Complications After Medical and Surgical Abortion. *Obstet Gynecol* 2009.

Table 3. Results of the Multivariable Analysis in Three Major Complications and Surgical (Re)Evacuation

	Hemorrhage		Infection	
	Medical	Surgical	Medical	Surgical
Age (y)	1.00 (0.96–1.04)			
Age category (y)				
Younger than 20	1	1	1	1
20–24	1.26 (1.00–1.58)	1.72 (1.25–2.37)	1.37 (1.03–1.83)	1.72 (1.13–2.62)
25–29	1.29 (0.88–1.91)	1.82 (1.30–2.54)	1.31 (0.95–1.80)	1.31 (0.77–2.23)
30–34	1.47 (0.83–2.58)	2.01 (1.45–2.79)	0.82 (0.56–1.19)	1.77 (1.02–3.08)
35–39	1.17 (0.56–2.46)	1.79 (1.28–2.52)	1.10 (0.77–1.58)	1.05 (0.54–2.01)
40 or older	1.01 (0.40–2.56)	0.50 (0.26–0.95)	0.95 (0.56–1.61)	1.54 (0.74–3.20)
Parity				
None	1			1
Yes	1.25 (1.08–1.45)			0.80 (0.56–1.14)
Previous abortion				
None	1			
Yes	1.07 (0.93–1.22)			
Social status				
Upper white-collar worker	1			1
Lower white-collar worker	1.14 (0.92–1.40)			3.21 (1.38–7.46)
Blue-collar worker	1.54 (1.23–1.93)			4.40 (1.87–10.36)
Student	1.50 (1.19–1.88)			3.47 (1.44–8.36)
Other	1.58 (1.20–2.08)			4.50 (1.80–11.27)
Marital status				
Married	1			
Cohabiting	1.12 (0.94–1.34)			
Single	1.05 (0.90–1.22)			
Residence				
Urban	1	1		1
Densely populated	1.43 (1.23–1.66)	0.98 (0.72–1.33)		0.85 (0.55–1.32)
Rural	1.25 (1.07–1.45)	0.71 (0.51–0.98)		0.54 (0.33–0.87)
Duration of gestation (d)				
42 or fewer	1		1	1
43–49	0.93 (0.82–1.05)		1.33 (0.98–1.80)	1.03 (0.59–1.80)
50–56	0.74 (0.64–0.85)		1.91 (1.42–2.56)	1.15 (0.68–1.94)
57–63	0.63 (0.51–0.76)		2.26 (1.62–3.15)	1.15 (0.68–1.96)

Data are odds ratio (95% confidence interval).  
Only those variables that showed a statistically significant association with a complication in univariable analysis (data not shown) were entered in multivariable analysis.

medical abortion is associated with uterine bleeding lasting approximately 2 weeks,<sup>23</sup> the high rate of consultation is not surprising. Uterine bleeding requiring surgical evacuation probably better reflects the severity of bleeding after termination of pregnancy. The incidence of such bleeding was relatively low, but it was more common in the medical-abortion group. In earlier studies, an average of 10% of women who underwent medical abortion complained of excessive bleeding.<sup>24</sup>

In line with uterine bleeding, the rate of incomplete abortion was higher in the cohort undergoing medical abortion. Surgical evacuation performed because of incomplete abortion occurred in approximately 6% of women having medical termination of pregnancy. The highest rates of complete medical

abortion, reported from centers with extensive experience of the technique, are up to 98%.<sup>11,25</sup> However, it is reassuring to note that a high rate of complete abortion, approaching those reported from centers with extensive experience, was reached in the present national cohort.

One of our key findings was that the rates of infectious morbidity were similar after medical and surgical abortion. In a previous survey, the need for postabortal antibiotics for suspected endometritis was higher after surgical abortion.<sup>26</sup> Moreover, the use of medical abortion previously has been associated with rare cases of severe infectious morbidity and mortality.<sup>27</sup> Reassuringly, only two cases with serious infections (septicemia caused by *Staphylococcus aureus* and *Streptococcus*) occurred in the present cohort, one in

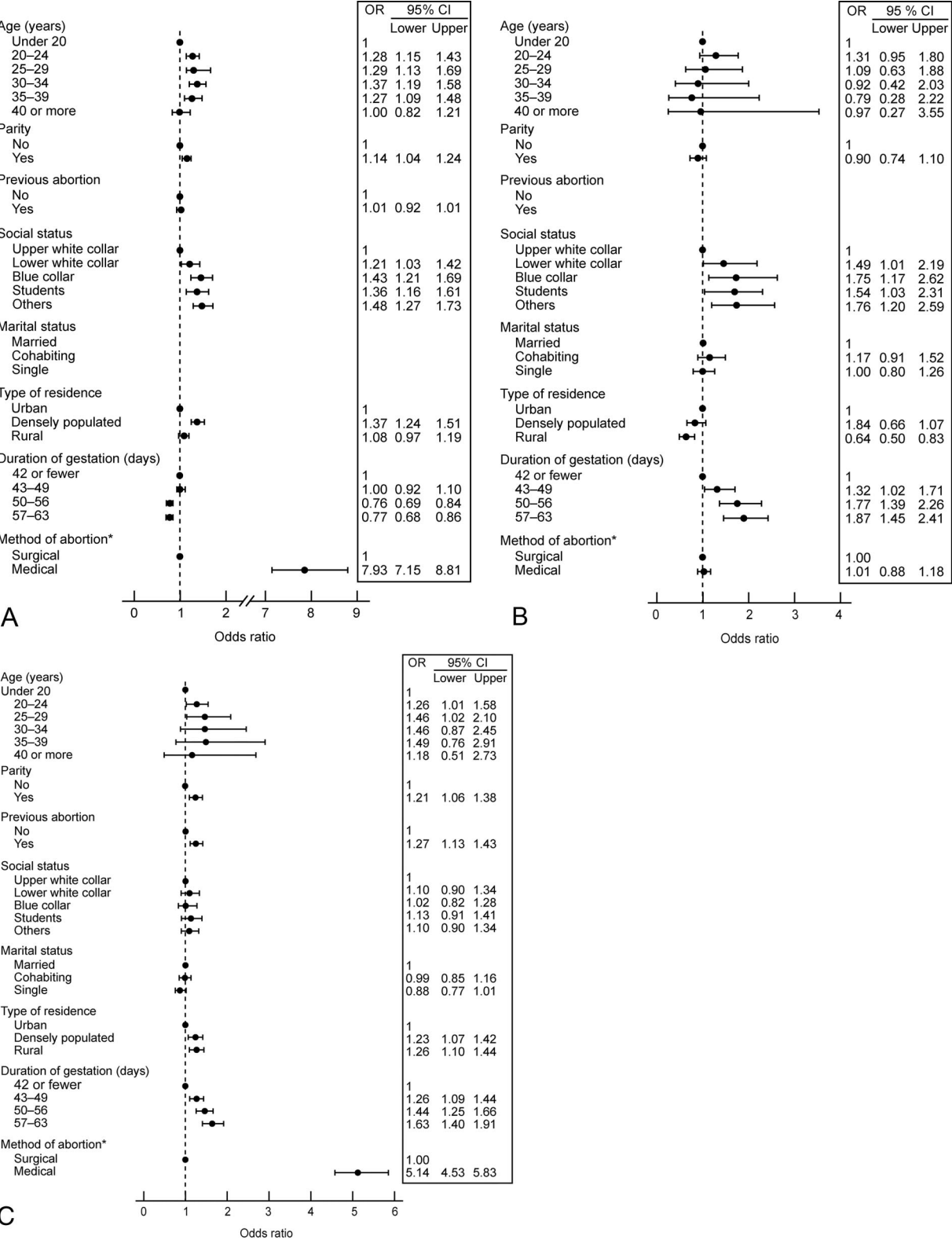
Incomplete Abortion		Surgical (Re)Evacuation	
Medical	Surgical	Medical	Surgical
1.04 (0.99–1.10)		1.05 (0.99–1.11)	
1		1	
1.14 (0.80–1.62)		1.15 (0.79–1.67)	
1.05 (0.60–1.86)		1.03 (0.56–1.88)	
0.89 (0.40–2.00)		0.89 (0.38–2.09)	
0.66 (0.23–1.88)		0.66 (0.22–2.00)	
0.41 (0.11–1.52)		0.39 (0.10–1.57)	
1		1	
1.65 (1.33–2.03)		1.59 (1.27–1.98)	
1	1	1	
1.34 (1.11–1.60)	1.38 (1.08–1.76)	1.30 (1.08–1.58)	
1		1	
0.97 (0.75–1.24)		0.97 (0.74–1.28)	
0.83 (0.62–1.11)		0.88 (0.65–1.20)	
1.04 (0.77–1.40)		1.02 (0.74–1.40)	
0.74 (0.50–1.08)		0.84 (0.57–1.25)	
1	1	1	
1.07 (0.84–1.35)	1.46 (1.00–2.13)	1.10 (0.86–1.41)	
0.94 (0.76–1.15)	1.46 (1.09–1.97)	0.92 (0.74–1.14)	
1		1	1
1.40 (1.13–1.74)		1.43 (1.14–1.79)	0.75 (0.52–1.08)
1.38 (1.12–1.70)		1.48 (1.19–1.84)	0.68 (0.48–0.96)
1	1	1	1
0.96 (0.78–1.16)	1.64 (0.97–2.75)	1.01 (0.81–1.24)	1.63 (0.97–2.73)
1.34 (1.12–1.66)	1.59 (0.96–2.62)	1.41 (1.14–1.75)	1.92 (1.17–3.15)
1.55 (1.22–1.98)	1.91 (1.16–3.14)	1.77 (1.38–2.28)	2.23 (1.36–3.65)

the medical and one in the surgical group. However, as previously reported, cases of *Clostridium sordellii* septicemia occurred at a rate of 1 per 100,000<sup>27</sup>; even the present cohort is too small to assess the incidence of such a rare infection.

Injuries and surgical interventions for other reasons were relatively rare in both groups. Not surprisingly, the incidence of postabortal surgical intervention was lower among women undergoing medical abortion. Some other serious and rare complications were identified as well. These included thromboembolic and psychiatric complications as well as some deaths. The incidence of thromboembolic complications is in line with earlier reports of an increased risk during pregnancy.<sup>28,29</sup> In a previous register-based study, it was concluded that deaths from external

causes of injury and poisoning (including unintentional and intentional injuries, suicides, and homicides) are significantly more common in women after induced abortion compared with nonpregnant women or women after birth.<sup>30</sup> In the present cohort also, five out of six cases of death were the result of external causes. In addition, psychiatric diagnoses, such as depression and psychoses, were identified, but the rates of these complications did not differ between the two cohorts. Similarly, in an earlier, partly randomized study, no differences between women with medically or surgically performed abortions emerged in regard to postabortal anxiety, depression, or self-esteem.<sup>31</sup> Naturally, the present kind of study setting (register-based study) gives only a crude idea of short-term psychiatric morbidity associated with termination of pregnancy.





**Fig. 2.** Risk factors regarding three major complications (bleeding [A], infection [B], and incomplete abortion [C]) among the entire cohort (medical and surgical cohorts combined). OR, odds ratio; CI, confidence interval. \*OR for infections is derived from univariable analysis.

Niinimäki. Complications After Medical and Surgical Abortion. *Obstet Gynecol* 2009.

The most important risk factor with regard to the two most common adverse events (hemorrhage and incomplete abortion) was the method of abortion. Other risk factors were, for the most part, in line with those reported previously—advanced gestational age, parity, and previous induced abortions.<sup>11,32–34</sup> For unknown reasons, the risk of hemorrhage after medical abortion diminished with advancing duration of gestation. Tolerance of bleeding—a natural part of medical abortion—varies from one woman and physician to another and also depends on preabortion counseling. Other explanations, such as possible bias in reporting the events in the registry, are possible but cannot be verified in the present study. We included all cases requiring consultation in specialized health care because they are registered uniformly in Finland. In addition, every such visit adds to the costs of the health care system. More detailed analysis of all health care costs related to termination of pregnancy and its complications, according to the method, is needed.

In conclusion, termination of pregnancy by means of either medical or surgical methods is associated with a low level of serious complications. On the basis of the present data, however, it appears that medical abortion results in an increased incidence of adverse events.

## REFERENCES

- Finer B, Henshaw SK. Disparities in rates of unintended pregnancy in the United States, 1994 and 2001. *Perspect Sex Reprod Health* 2006;38:90–6.
- Jones RK, Zolna MR, Henshaw SK, Finer LB. Abortion in the United States: incidence and access to services, 2005. *Perspect Sex Reprod Health* 2008;40:6–16.
- National Institute for Health and Welfare: Induced abortions. Available at: <http://www.stakes.fi/EN/tilastot/statisticsbytopic/reproduction/abortions.htm>. Retrieved February 5, 2009.
- The National Board of Health and Welfare. Available at: <http://www.socialstyrelsen.se/>. Accessed February 5, 2009.
- Department of Health. Available at: [www.dh.gov.uk](http://www.dh.gov.uk). Accessed February 5, 2009.
- Zhou W, Nielsen GL, Moller M, Olsen J. Short-term complications after surgically induced abortions: a register-based study of 56 117 abortions. *Acta Obstet Gynecol Scand* 2002; 81:331–6.
- Say L, Kulier R, Gulmezoglu M, Campana A. Medical versus surgical methods for first trimester termination of pregnancy. *The Cochrane Database of Systemic Reviews* 2005, Issue 1. Art.No.: CD003037. DOI:10.1002/14651858.CD003037.pub2.
- Rorbye C, Norgaard M, Nilas L. Medical versus surgical abortion efficacy, complications and leave of absence compared in a partly randomized study. *Contraception* 2004;70: 393–9.
- Ashok PW, Kidd A, Flett GM, Fitzmaurice A, Graham W, Templeton A. A randomized comparison of medical abortion and surgical vacuum aspiration at 10–13 weeks gestation. *Hum Reprod* 2002;17:92–8.
- Henshaw RC, Naji SA, Russell IT, Templeton AA. A comparison of medical abortion (using mifepristone and gemeprost) with surgical vacuum aspiration: efficacy and early medical sequelae. *Hum Reprod* 1994;9:2167–72.
- Ashok PW, Templeton A, Wagaarachchi PT, Flett GM. Factors affecting the outcome of early medical abortion: a review of 4132 consecutive cases. *BJOG* 2002;109:1281–9.
- Niinimäki M, Pouta A, Bloigu A, Gissler M, Hemminki E, Suhonen S, et al. Frequency and risk factors for repeat abortions after surgical compared with medical termination of pregnancy. *Obstet Gynecol* 2009;113:845–52.
- Finlex. <http://www.finlex.fi/fi/laki/ajantasa/1970/19700239?search%5Btype%5D=pika&search%5Bpika%5D=raskau%2A>. Retrieved January 21, 2009.
- Finnish Gynecological Association's task force. Abortion. *Duodecim* 2001;117:2084–94.
- National Institute for Health and Welfare: Institutional health care. Available at: <http://www.stakes.fi/EN/tilastot/statisticsbytopic/healthservices/institutionlahealthcare.htm>. Accessed January 27, 2009.
- Statistics Finland. Available at: [www.stat.fi](http://www.stat.fi). Accessed January 27, 2009.
- World Health Organization. Available at: <http://www.who.int/classifications/icd/en/>. Accessed January 27, 2009.
- Nordic Centre for Classifications in Health Care. <http://www.nordclass.uu.se/>. Accessed January 27, 2009.
- Induced abortion operations and their early sequelae. Joint study of the Royal College of General Practitioners and the Royal College of Obstetricians and Gynaecologists. *J R Coll Gen Pract* 1985;35:175–80.
- Gissler M, Berg C, Bouvier-Colle MH, Buekens P. Pregnancy-associated mortality after birth, spontaneous abortion, or induced abortion in Finland, 1987–2000. *Am J Obstet Gynecol* 2004;190:422–7.
- Deneux-Tharaux C, Berg C, Bouvier-Colle MH, Gissler M, Harper M, Nannini A, et al. Underreporting of pregnancy-related mortality in the United States and Europe [published erratum appears in *Obstet Gynecol* 2005;107:209]. *Obstet Gynecol* 2005;106:684–92.
- Gissler M, Ulander VM, Hemminki E, Rasimus A. Declining induced abortion rate in Finland: data quality of the Finnish abortion register. *Int J Epidemiol* 1996;25:376–80.
- Spitz IM, Bardin CW, Benton L, Robbins A. Early pregnancy termination with mifepristone and misoprostol in the United States. *N Engl J Med* 1998;338:1241–7.
- Sitruk-Ware R. Mifepristone and misoprostol sequential regimen side effects, complications and safety. *Contraception* 2006;74:48–55.
- Ashok PW, Penney GC, Flett GM, Templeton A. An effective regimen for early medical abortion: a report of 2000 consecutive cases. *Hum Reprod* 1998;13:2962–5.
- Cameron ST, Glasier AF, Logan J, Benton L, Baird DT. Impact of the introduction of new medical methods on therapeutic abortions at the Royal Infirmary of Edinburgh. *Br J Obstet Gynaecol* 1996;103:1222–9.
- Fischer M, Bhatnagar J, Guarner J, Reagan S, Hacker JK, Van Meter SH, et al. Fatal toxic shock syndrome associated with clostridium sordellii after medical abortion. *N Engl J Med* 2005;353:2352–60.
- Heit JA, Kobbervig CE, James AH, Petterson TM, Bailey KR, Melton LJ, 3rd. Trends in the incidence of venous thromboembolism during pregnancy or postpartum: a 30-year population-based study. *Ann Intern Med* 2005;143:697–706.



29. James AH, Jamison MG, Brancazio LR, Myers ER. Venous thromboembolism during pregnancy and the postpartum period: incidence, risk factors, and mortality. *Am J Obstet Gynecol* 2006;194:1311–5.
30. Gissler M, Berg C, Bouvier-Colle MH, Buekens P. Injury deaths, suicides and homicides associated with pregnancy, Finland 1987–2000. *Eur J Public Health* 2005;15:459–63.
31. Henshaw R, Naji S, Russell I, Templeton A. Psychological responses following medical abortion (using mifepristone and gemeprost) and surgical vacuum aspiration. A patient-centered, partially randomised prospective study. *Acta Obstet Gynecol Scand* 1994;73:812–8.
32. Bartley J, Tong S, Everington D, Baird DT. Parity is a major determinant of success rate in medical abortion: a retrospective analysis of 3161 consecutive cases of early medical abortion treated with reduced doses of mifepristone and vaginal gemeprost. *Contraception* 2000;62:297–303.
33. Allen RH, Westhoff C, De Nonno L, Fielding SL, Schaff EA. Curettage after mifepristone-induced abortion: frequency, timing, and indications. *Obstet Gynecol* 2001;98:101–6.
34. Child TJ, Thomas J, Rees M, MacKenzie IZ. A comparative study of surgical and medical procedures: 932 pregnancy terminations up to 63 days gestation. *Hum Reprod* 2001;16: 67–71.



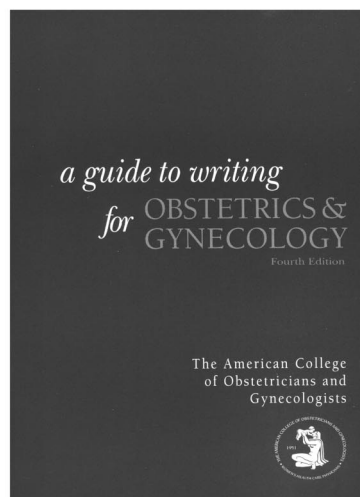
## Updated Fourth Edition Available

*A Guide to Writing for Obstetrics & Gynecology* has been updated to help prospective authors, especially those who are beginning in medical journal writing, produce better papers.

Topics covered include:

- New conflict of interest policy
- Updated levels of evidence
- Planning and structuring a manuscript
- Writing tips, including an overview of syntax, grammar, abbreviations, acronyms, jargon, and troublesome terms
- Common pitfalls of authorship (eg, redundant publication and conflict of interest)
- An overview of the peer-review process

Copies of this valuable resource are available, free of charge, from *Obstetrics & Gynecology*. Requests may be submitted by fax (202-479-0830) or e-mail (obgyn@greenjournal.org).



rev 10/2008

